Overview of Mobile Air Conditioning

CARB March 2003

Ward Atkinson
Sun Test Engineering

System Emissions & Sources

Direct Emissions = Refrigerant Emissions

- Compressor seal leakage
- Joint leakage
- Hose permeation
- Hose coupling leakage
- Losses during crash, service, & scrap

Indirect Emissions = CO_2 from Energy Use

- CO_2 as tailpipe emissions from operating system and carrying weight of A/C System
- Can also include 'cradle-to-grave' CO_2 emissions from all energy to produce components, and energy to scrap/recycle every system component

Recovering Refrigerant

- On Site Recovery and Recycling of Refrigerant Is Beneficial For The Environment
- It's Required Under Federal Law

Recovery/Recycling At Service and Scrap

- Reduces Lifetime New Refrigerant Requirements By 60%
  - Mobile Air Conditioning Society Service Survey

Sale of HFC-134a

- General Public Can Freely Purchase HFC-134a and Charging Hoses
- Clean Air Act Prohibits Venting of CFC-12 and HFC-134a During Mobile A/C Service
  - R&R Equipment Required at Service Shops
- DIY's Must Comply With Refrigerant Containment --- No Enforcement

Refrigerant Issues

- **HFC-134a Emissions Can Be Reduced**
- **MACS Environmental Actions Has Requested EPA To:**
  - **Require Federal Certification To Purchase HFC-134a** (Implement Current Law)
  - **Eliminate Small Containers Of HFC-134a** (Only 30 Pounds or Larger)

R134a Mobile A/C Emission Reduction

- Require Repair of Leaking Systems
  - Florida Issue
- No "Top Off" Refrigerant Service
  - Remove and Charge Correct amount
- Sale of Refrigerant to Only Certified Technicians
- Recover Refrigerant at Vehicle Scrap

Fleet Contamination Issue

- **Industry Only Recommends HFC-134a**
  - **(New Vehicles -Retrofit)**
  - **Service Equipment Including Recovery/Recycling**
- EPA Has Listed **10** Refrigerants For Mobile Use - No Testing !!!!
  - **Refrigerants Are Blends --- Some Contain HCFC's**
  - **No Recovery/Recycling Equipment --- Mixing--- Venting**

System Charge

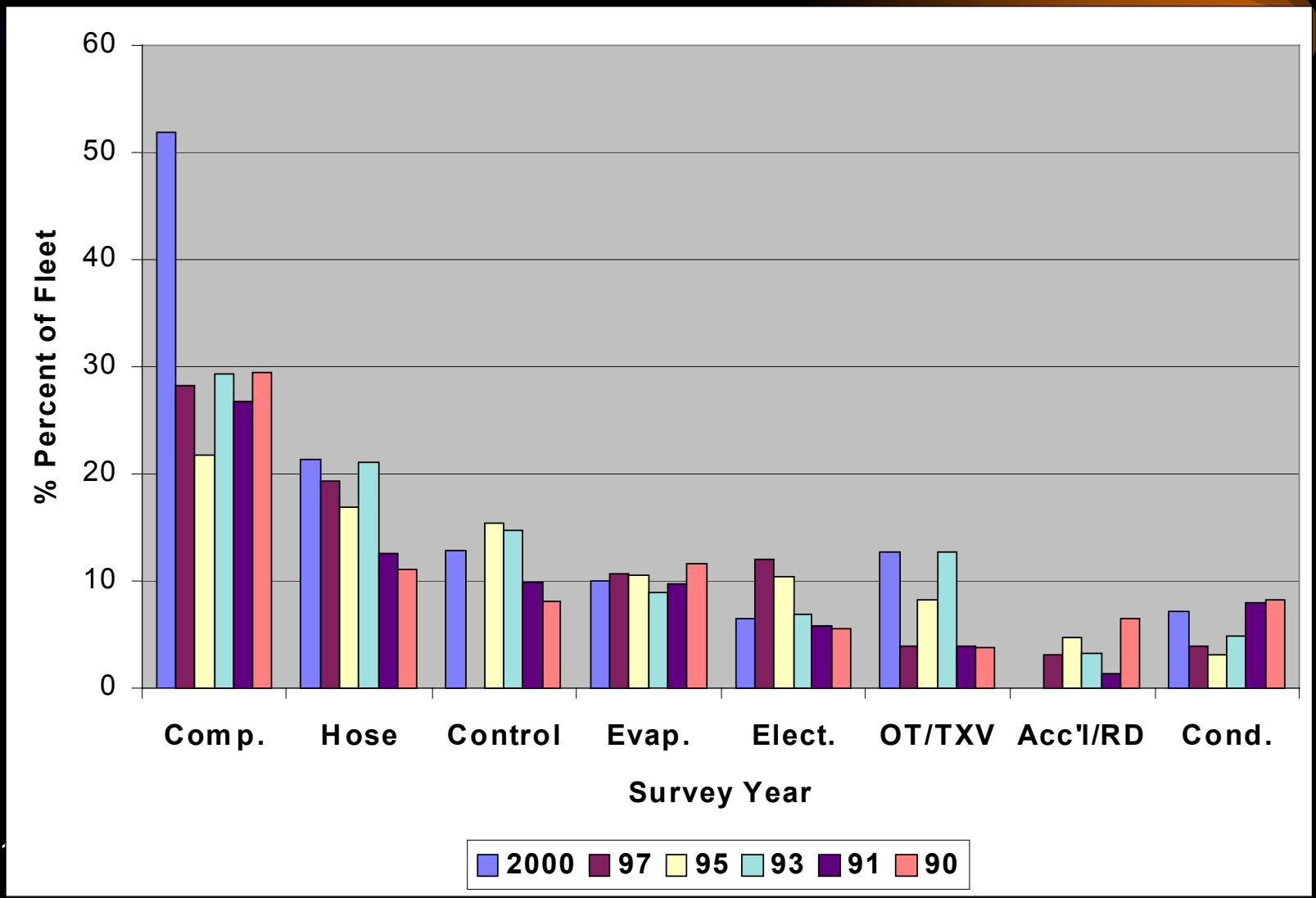
- Current and Future Systems Are "Charge Sensitive"
- To Assure Performance Requires More Precise Refrigerant Charge
- Cannot Be Achieved With Small Cans

2000 Field Survey

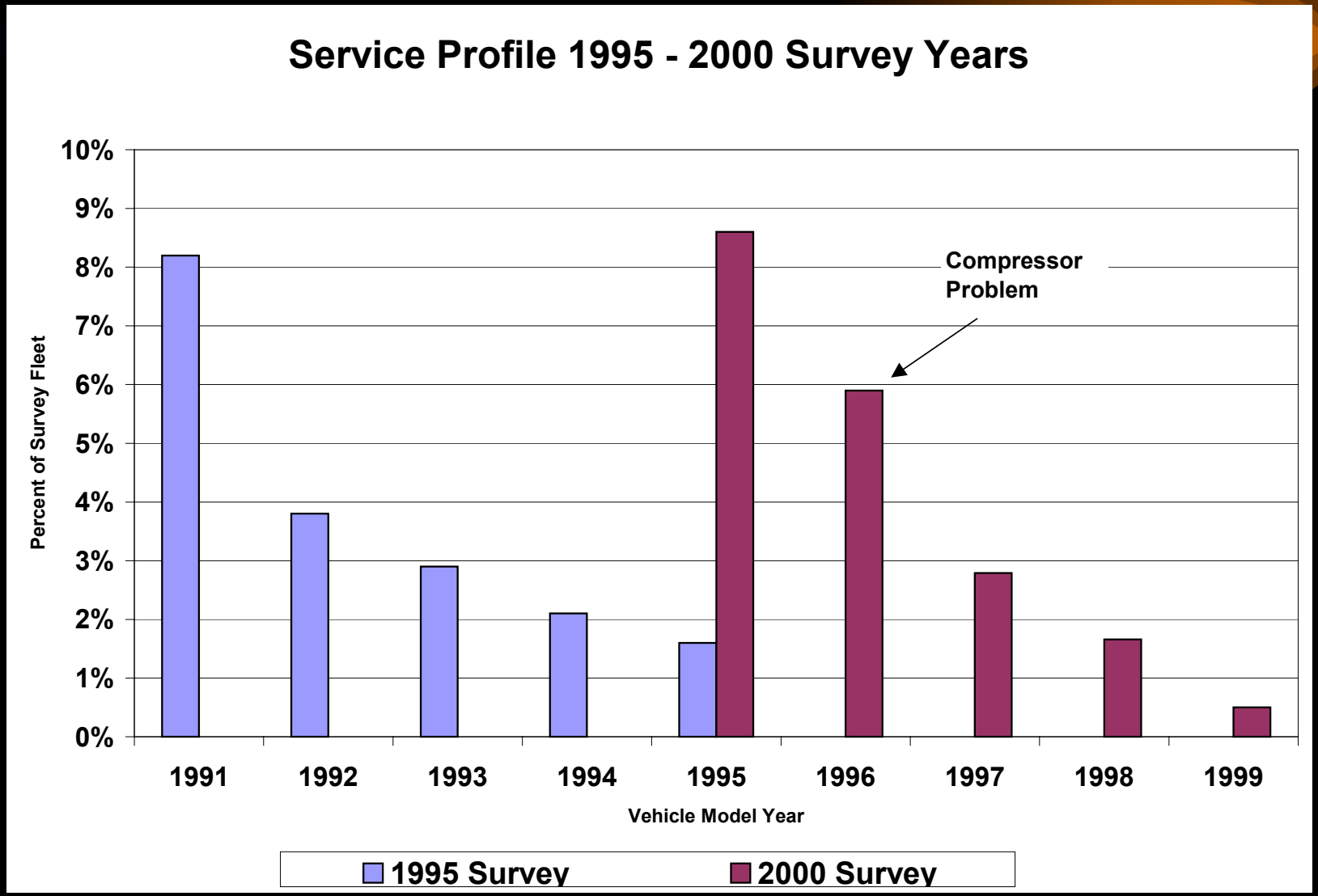
MACS Field Survey

- Over 10 Years MACS Members Have Conducted 6 Field Surveys
- Results Have Been Used By
  - Vehicle And System Manufacturers
  - Equipment Manufacturers
  - Governmental Agencies

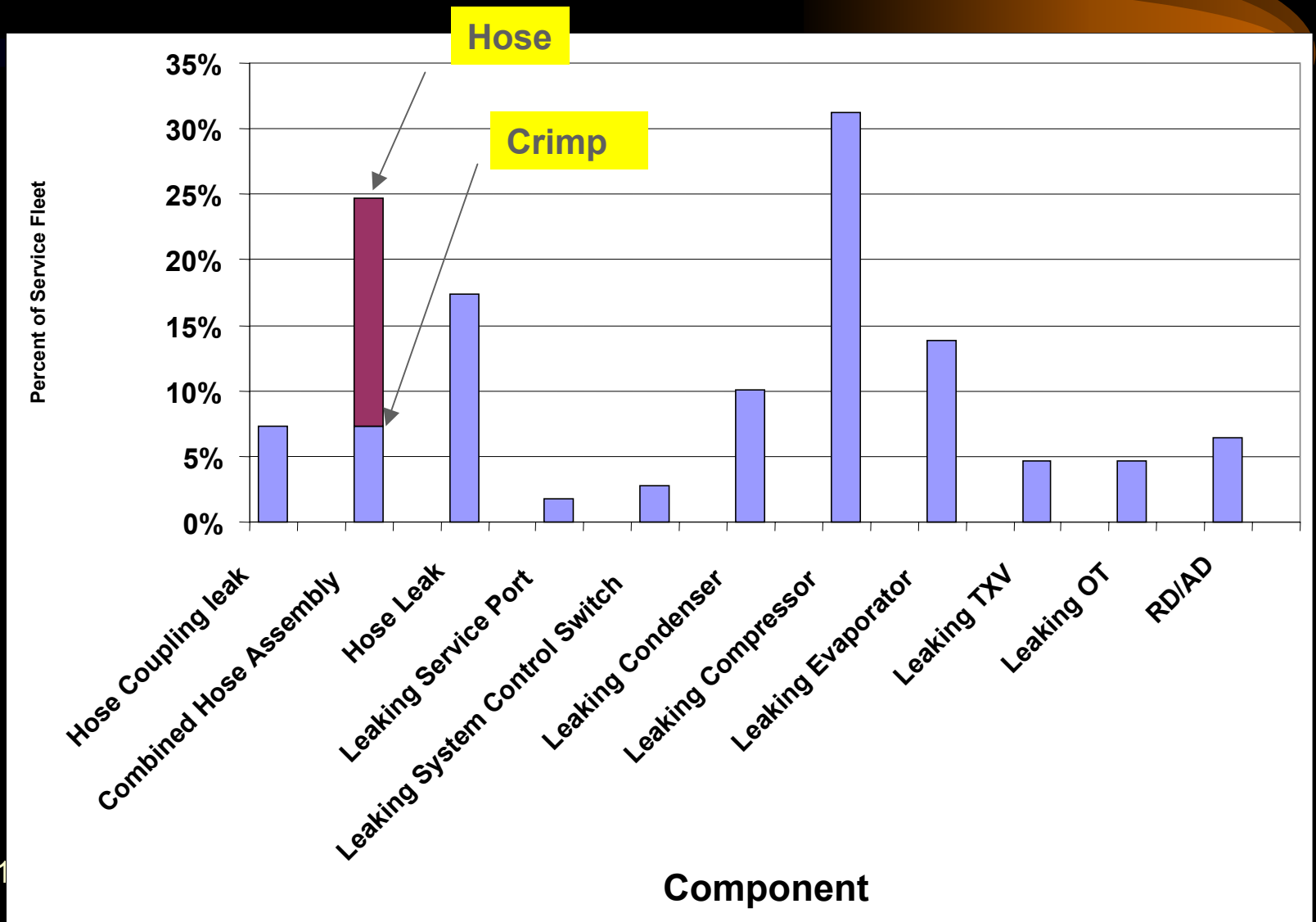
Reason For Service
MACS Surveys



Service of 1 to 5 Year Old Systems Out of Warranty



Component Servicing



System Leakage

- Two Major Items
  - Compressor
  - Flexible Hoses

Component Servicing

MACS 2000 Survey

- Compressor Leakage 31.2% of Service Fleet
- Hose Assembly 24.7% of Service Fleet
  - Coupling 7.3%
  - Hose 17.4%
    - Unknown?
      - Abrasion?
      - Cuts?
      - Other?

MACS 2002 Refrigerant Survey

- Type of Systems Serviced
  - R-12 26%
  - R-134a 74%
- Refrigerant Contamination Fleet avg. 12.7%
- Refrigerant Contamination Hydrocarbon 6.4%
- Retrofitted CFC-12 Fleet
  - Meeting EPA Requirements 31.6%
- Fleet Older Than 1995 49.4%

Mobile Air Conditioning Systems (Future)

- Electronic Controlled
  Compressors
  Refrigerant Controls

- New Service Equipment [New Refrigerants]

- Improved Service Technician Training
  More complex systems for DIYers to repair

MACS 2003 Field Survey

Summer 2003

Goals of MACS Field Survey

- **Provide Profiles Of Current Service Activities**
  - **Required Repair Frequency Profile**
  - **Amount of Recoverable Refrigerant**
  - **Types of component failures**

MACS 2003 Survey

- 28 Survey Categories Including:
  - Ownership
  - Reason For Service
  - Type of Service
  - Components Replaced
  - Repair Cost

MACS 2003 Survey Listening Post

- Provide Two Page Questionnaire on Your Customer Service Activity
  - Coverage Period May to September 2003
- Provide At Least 30 Surveys Per Month

2003 Field Survey Questions

- Recovered Refrigerant

Was the amount of refrigerant recovered identifiable? Yes ☐ No ☐
If so how much was recovered before servicing the system?
1 lb. 2 oz.

- Component Leak

Hose Assembly: At Hose Crimp ☐ Leaking Hose (not at Crimp) ☐
Compressor: Shaft Seal ☐ Seal/O-ring Compressor body/case ☐

SAE Alternate Refrigerant

SAE ARCRP Goal

The initial goal is to compare the energy usage and cooling performance of future systems to the current HFC-134a system under controlled laboratory conditions at a recognized test facility.

The project will be completed in early 2003

SAE Alternate Refrigerant Cooperative Research Program

- Sponsored by 25 Industry Stakeholders
  - Vehicle Makers, Suppliers, Government Agencies
- Core Team Consists of Global Vehicle Makers
  - Chaired by Ward Atkinson
- Expert Advisors Overseeing Research From
  - Daimler-Chrysler
  - Ford
  - General Motors
  - Volvo
- Systems Being Tested
  - Current HFC-134a
  - Enhanced HFC-134a
  - Carbon Dioxide
  - Secondary Loop

SAE ARCRP System Energy Analysis

Proposal for reducing data to annualized number